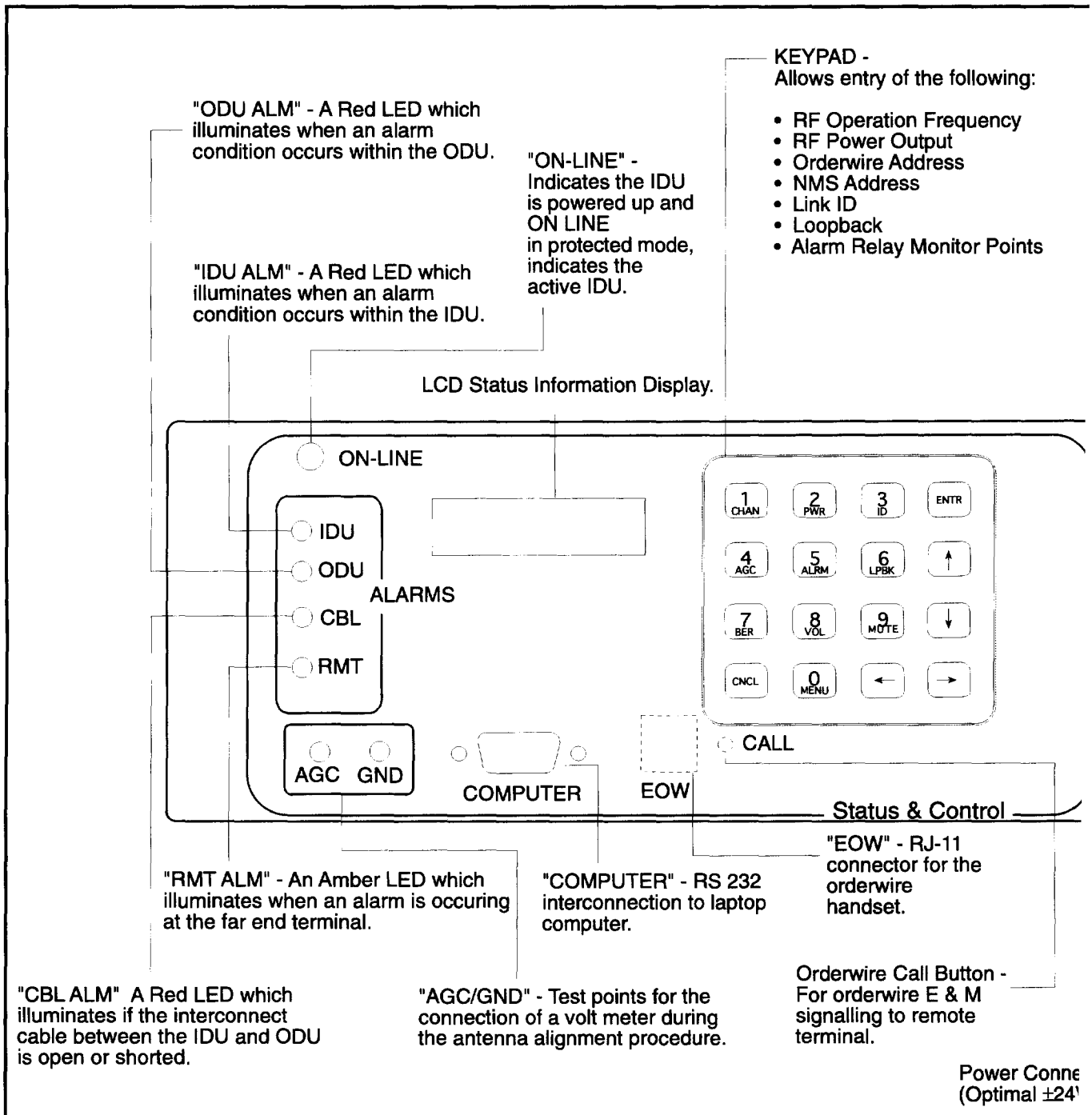
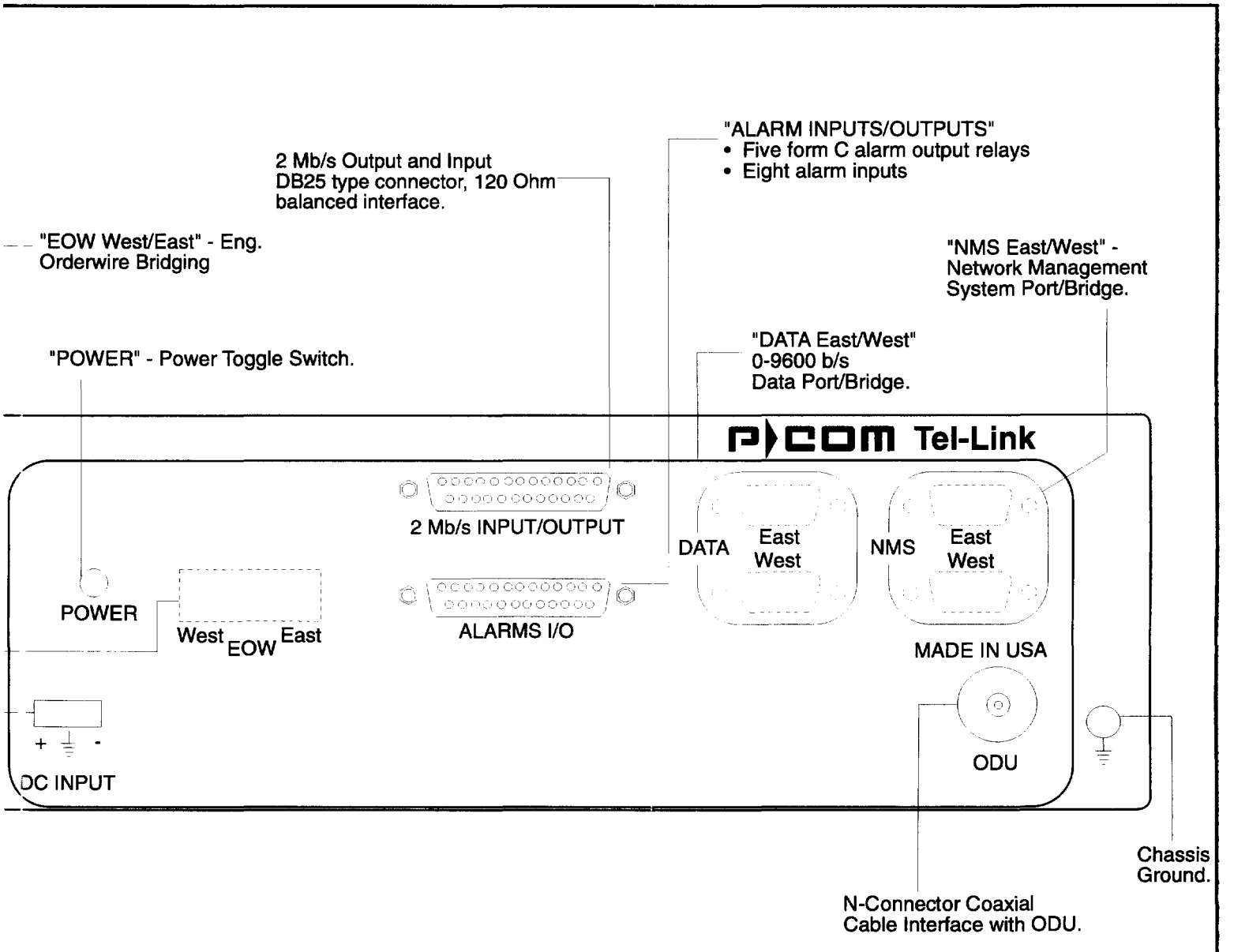


Note: Features shown with dashed lines indicate an option.

Figure 3.11 – Indoor Unit (IDU) Front Panel Features, Keypad Version with 120 Ohm Data Interface



)r - 48VDC
C).

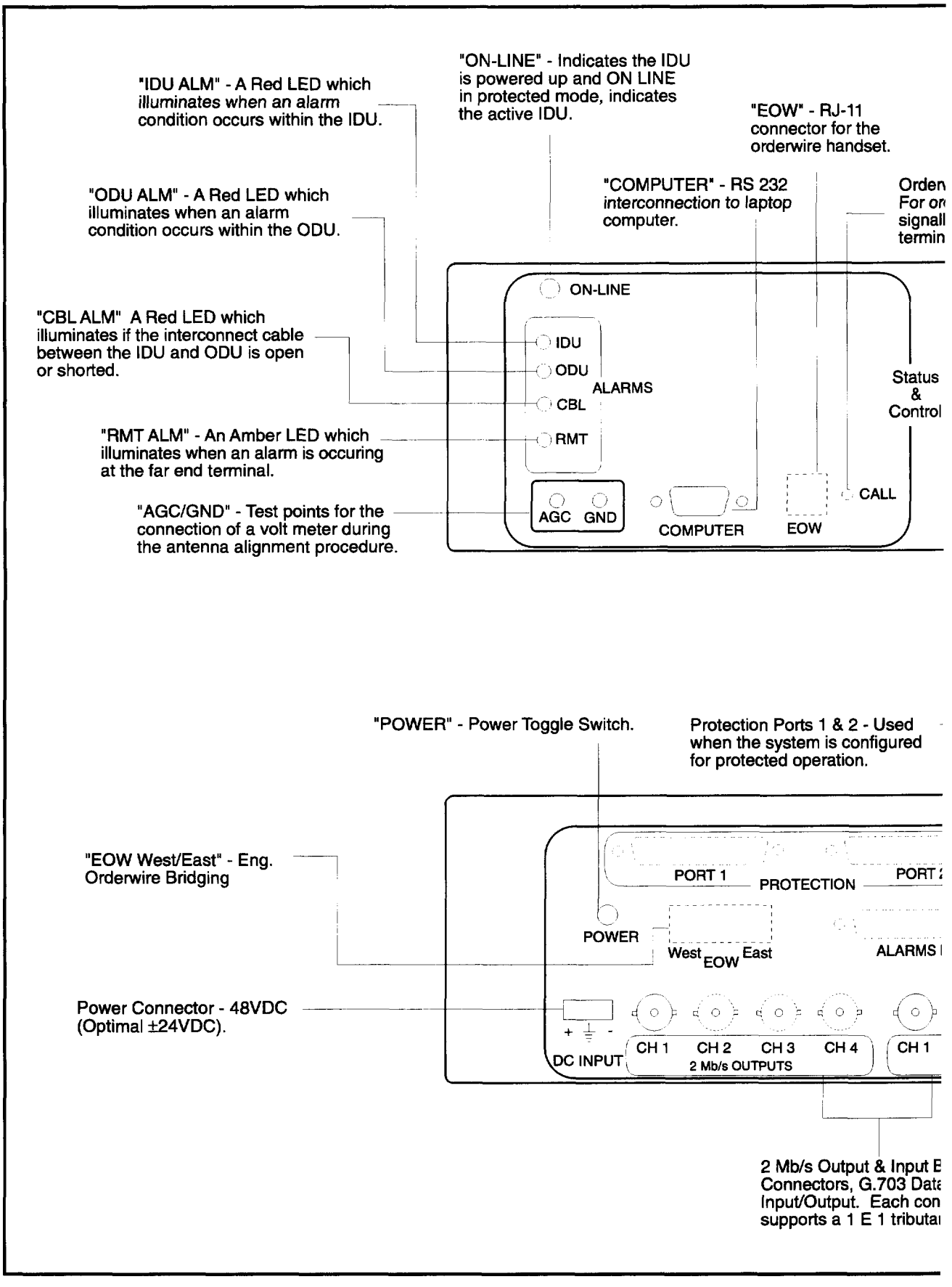
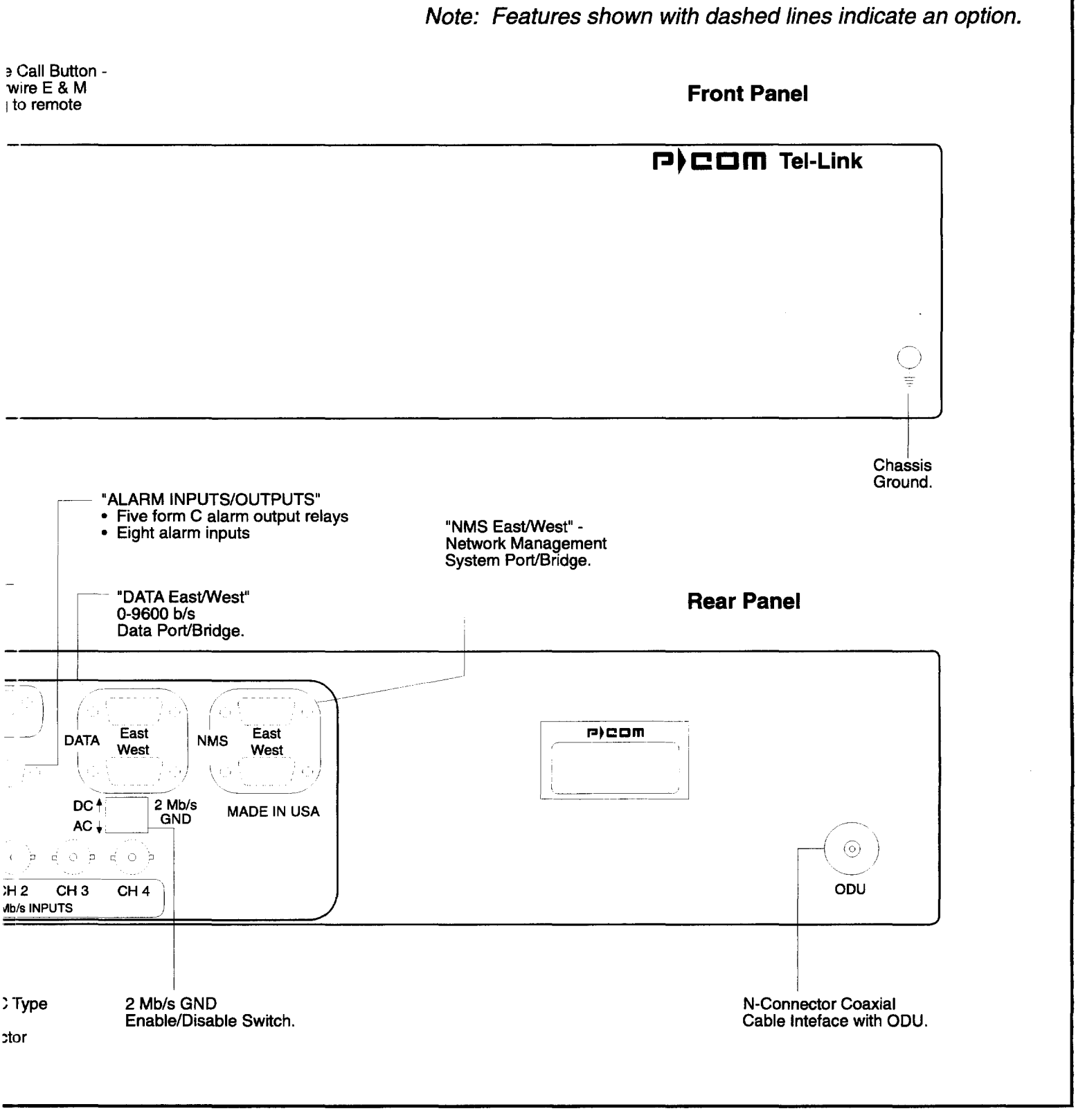

"IDU ALM" - A Red LED which illuminates when an alarm condition occurs within the IDU.
"ON-LINE" - Indicates the IDU is powered up and ON LINE in protected mode, indicates the active IDU.
"EOW" - RJ-11 connector for the orderwire handset.
"ODU ALM" - A Red LED which illuminates when an alarm condition occurs within the ODU.
"COMPUTER" - RS 232 interconnection to laptop computer.
Orden
For or
signall
termin
ON-LINE
"CBL ALM" A Red LED which illuminates if the interconnect cable between the IDU and ODU is open or shorted.
IDU
ODU
CBL
RMT
ALARMS
Status & Control
"RMT ALM" - An Amber LED which illuminates when an alarm is occuring at the far end terminal.
"AGC/GND" - Test points for the connection of a volt meter during the antenna alignment procedure.
AGC
GND
COMPUTER
EOW
CALL
"POWER" - Power Toggle Switch.
Protection Ports 1 & 2 - Used when the system is configured for protected operation.
"EOW West/East" - Eng. Orderwire Bridging
PORT 1
PROTECTION
POWER
West
EOW
East
ALARMS
Power Connector - 48VDC (Optimal ±24VDC).
+
-
DC INPUT
CH 1
CH 2
CH 3
CH 4
CH 1
2 Mb/s OUTPUTS
2 Mb/s Output & Input E
Connectors, G.703 Data
Input/Output. Each con
supports a 1 E 1 tributar

Figure 3.12 – Indoor Unit (IDU) Front/Rear Access Features, Basic Version with 75 Ohm Data Interface



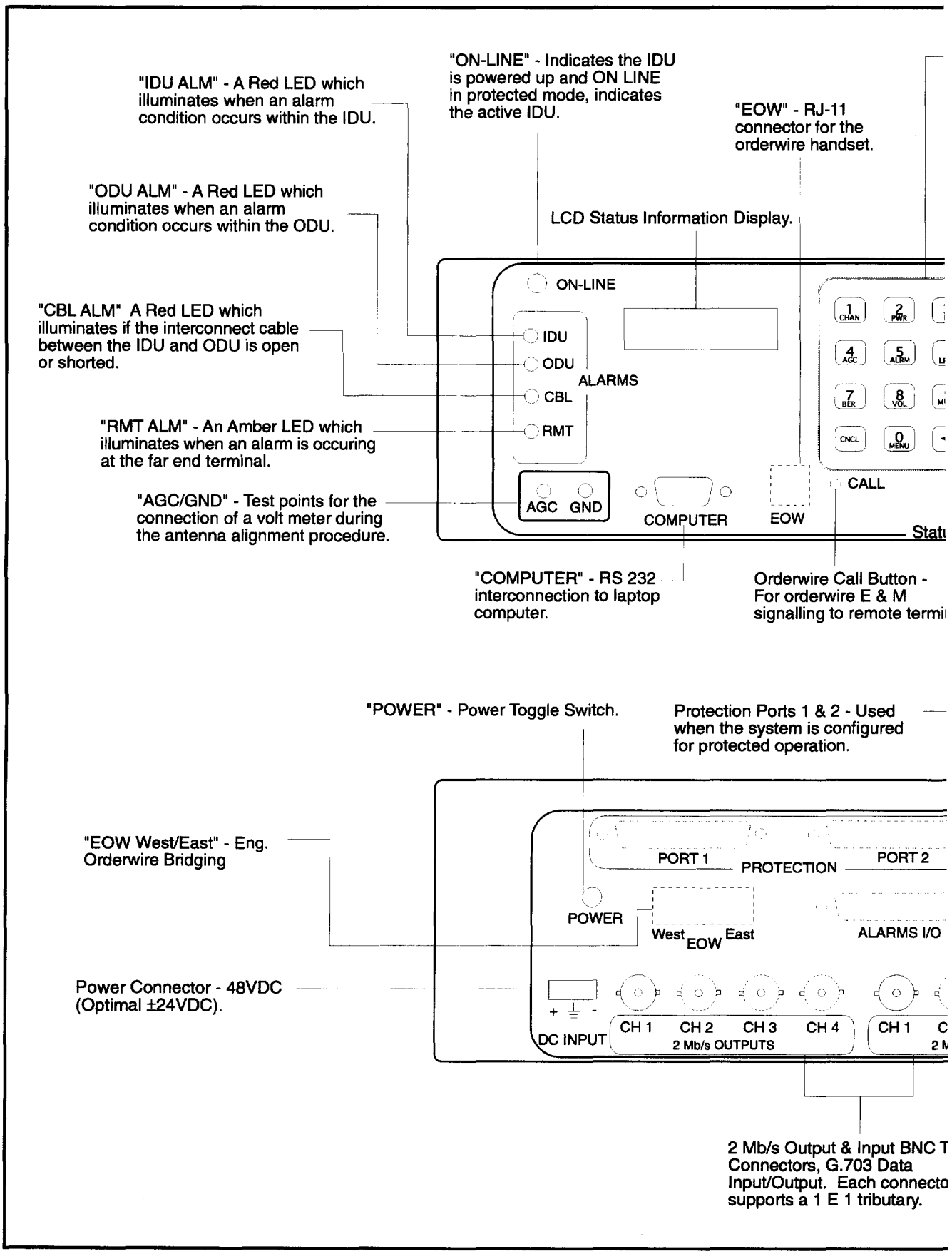
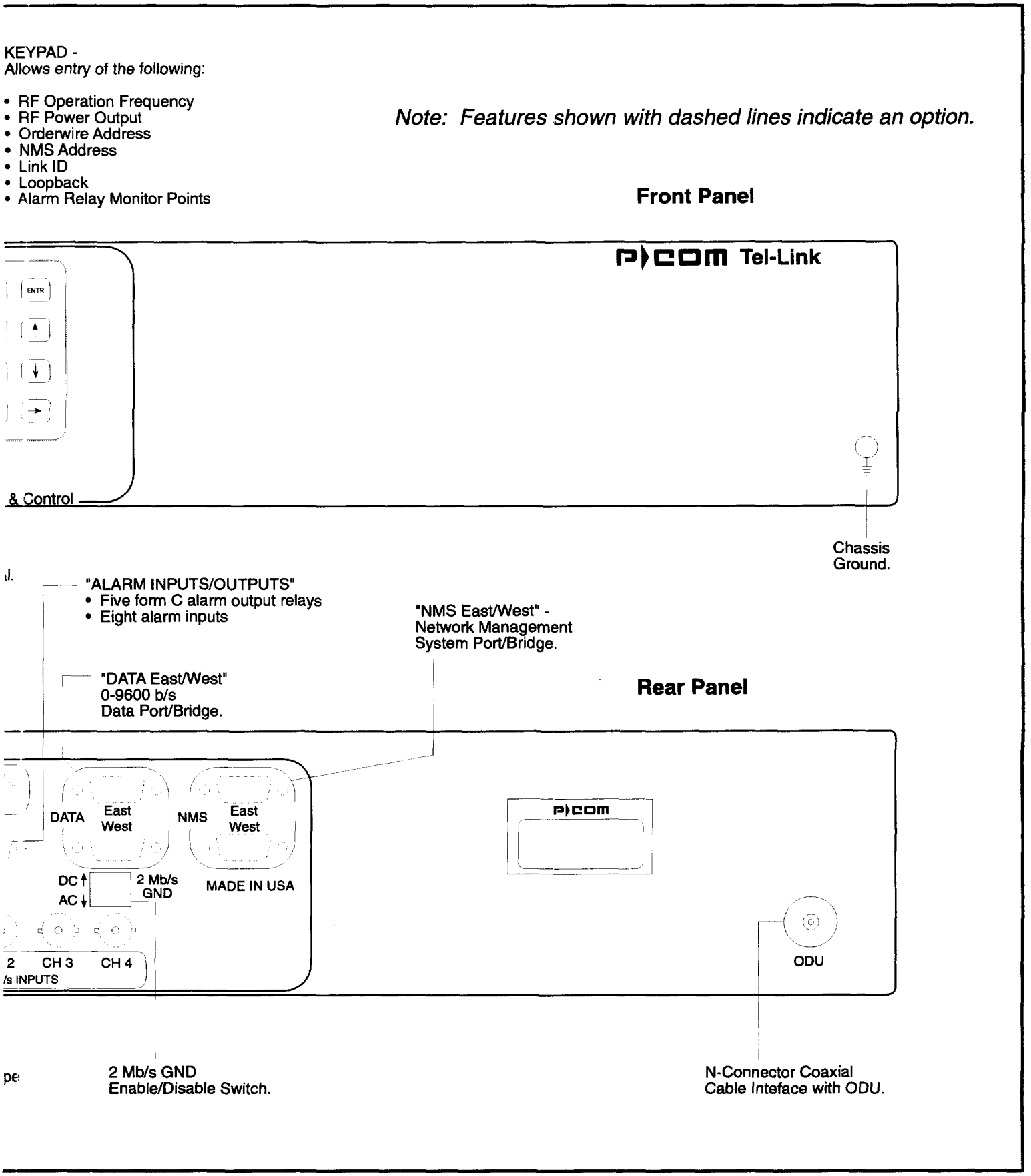

"IDU ALM" - A Red LED which illuminates when an alarm condition occurs within the IDU.
"ON-LINE" - Indicates the IDU is powered up and ON LINE in protected mode, indicates the active IDU.
"EOW" - RJ-11 connector for the orderwire handset.
"ODU ALM" - A Red LED which illuminates when an alarm condition occurs within the ODU.
LCD Status Information Display.
"CBL ALM" A Red LED which illuminates if the interconnect cable between the IDU and ODU is open or shorted.
ON-LINE
IDU
ODU
CBL
RMT
ALARMS
"RMT ALM" - An Amber LED which illuminates when an alarm is occuring at the far end terminal.
"AGC/GND" - Test points for the connection of a volt meter during the antenna alignment procedure.
AGC GND
COMPUTER
EOW
CALL
"COMPUTER" - RS 232 interconnection to laptop computer.
Orderwire Call Button - For orderwire E & M signalling to remote termi
"POWER" - Power Toggle Switch.
Protection Ports 1 & 2 - Used when the system is configured for protected operation.
"EOW West/East" - Eng. Orderwire Bridging
PORT 1
PROTECTION
PORT 2
POWER
West EOW East
ALARMS I/O
Power Connector - 48VDC (Optimal ±24VDC).
DC INPUT
CH 1 CH 2 CH 3 CH 4
2 Mb/s OUTPUTS
CH 1
2 Mb/s Output & Input BNC T Connectors, G.703 Data Input/Output. Each connecto supports a 1 E 1 tributary.

Figure 3.13 – Indoor Unit (IDU) Front/Rear Access Features, Keypad Version with 75 Ohm Data Interface



4.0 Deployment Concepts

4.1 Installation

Installation of the Tel-Link Radio consists of the following steps:

ODU and IDU:

- ODU/Antenna mounting
- IDU mounting
- ODU-IDU cable installation
- Power and ground cabling
- E1 signals terminated to a defined demarcation
- Alarm inputs and outputs terminated to a defined demarcation
- Interconnections for orderwire, data channel and network management communication signals at junction sites

Stand-by Power:

- Mount batteries
- Mount charger (rack mounted, collocated with radio equipment)
- Power and ground cabling
- Alarm inputs terminated to a defined demarcation

Network Management System:

- Install Network Manager hardware
- Install NMS Software
- Power and ground cabling
- Communications signal cabling to defined demarcation
- Install Dial-in access port terminated to defined demarcation

4.1.1 Commissioning

ODU and IDU:

- Antenna alignment
- Verify RSL
- RF loop testing, if applicable
- E1 loop testing
- E1 BER testing

Stand-by Power:

- Manufacturer recommended testing and alignment procedures
- Verification of stand-by power equipment alarms
- Verification of operation with the installed network management system

Network Management System:

- Network Manager alarm indication verification
- Network Manager report generation and printer verification
- Dial-in access verification

Installation and commissioning may be provided by P-Com, subcontracted or carried out by the end user.

4.1.2 Spares

Two spare ODUs, one for high band and one for low band, are suggested for each 20 links. One spare IDU is suggested for each 20 links of 1E1 radio, each 20 links of 2E1 radio and each 20 links of 4E1 radio.

4.1.3 Repair and Return Policy

P-Com's policy regarding the servicing of customer equipment faults is comprised of three levels of priority. Depending on the situation, the policy corresponding to the proper priority dictates the action.

Priority 1: Telephone Troubleshooting Services.

P-Com provides a 24 hour a day telephone technical support service.

Priority 2: Repair and Return.

Once an equipment problem has been identified and after the telephone technical support service has been exhausted, the customer will be given a Return Material Authorization (RMA) number. The customer ships the faulty equipment with the assigned RMA identification, at his own cost, to the factory in Campbell, CA, USA or to the closest P-Com service depot. Upon receipt, P-Com will place the equipment in the repair and return process where it will be inspected and repaired in turn. The equipment will then be returned to the customer. The expense for the return of the equipment will be paid by P-Com during the warranty period (12 months) and will be the customer's responsibility after the warranty period expires. The typical time required for this process to take place is approximately four weeks.

If the user does not have a replacement spare, P-Com will ship within 24 hours, a loaner unit to the customer. This unit is on loan to the customer until the faulty units have been repaired by P-Com. The repair of the faulty units is bound by the P-Com repair and return policy stated above. However, for quick recovery, P-Com recommends that the customer keep spare units on site (see section 3.3 c).

Priority 3: On Site Service.

If a chronic, design-related equipment fault arises with P-Com equipment that is under warranty (the P-Com warranty is 12 months from date of shipment, or commissioning, whichever is applicable) and a site visit is deemed necessary, P-Com technical personnel will be sent, at P-Com's expense, to the required customer site to remedy the problem.

If the equipment is out of warranty, P-Com reserves the right to require the customer to pay for technical service, transportation, lodging and food costs.

4.1.4 Tools and Service Equipment

The Tel-Link Series has been designed to require a minimum amount of tools and test equipment for installation. Moreover, this radio system requires no specialized test equipment.

Suggested tools for installation, commissioning and maintenance are:

- Metric wrenches
- Screwdrivers
- Crimp tool for "N" connector
- Wire cutters
- Binoculars
- Voltmeter, analog or digital

Suggested test equipment for installation, commissioning and maintenance is:

- Laptop PC (Optional - only required if the user desires additional diagnostics and control capability; system does not require this for installation, commissioning or maintenance).
- Bit Error Rate test set

4.1.5 Maintenance

No special extender cards or service kits are necessary for the maintenance of modules. The Tel-Link series modules do not require routine maintenance. The O & M approach to P-Com's radio has been "designed-in"; this approach to the equipment is a major feature of P-Com's deployment philosophy, which aims at minimizing:

- Downtime
- Field replacement procedures
- Field realignment procedures
- Field test equipment and tools
- Required expertise of field personnel

The ODU active components have been minimized in order to increase its MTBF and thereby reduce the need of replacement to a very unlikely event. Even where that event does occur, the procedure to identify, remove and replace the ODU is simple. A conic circular waveguide to antenna feed connector eliminates any need for a flange connection. The faulty ODU slides out; the replacement ODU slides in. No tools are necessary. Since, the ODU operates in a wideband mode, no realignment or adjustments are necessary after replacement. Replacement of a faulty IDU merely involves a shelf change; the faulty IDU is removed from the rack and the new IDU is installed. The single coaxial cable between the ODU and IDU adds to the simplicity of this process.

Considering the O & M philosophy described above, maintenance of P-Com's Tel-Link Radio is simply a repair and return endeavor which can be billed on a per consumption "a posteriori" basis. However, for further precaution, P-Com is willing to enter into a contract of maintenance including:

- Routine (preventative) maintenance
- Corrective maintenance

4.1.6 Deployment

The typical installation of the Tel-Link Radio can be described in terms of the installation of one link. The installation of one link will require two technicians, one for each end. Average travel time to the site is assumed to be 30-60 minutes. Once the technicians have arrived at the site, it will take approximately 30 minutes to install the IDU. It will take each technician approximately one hour to mount each ODU. Once the IDUs and ODUs have been mounted, the cable is installed. Installation and connection of the cable will take about 30 minutes per site (it is advisable to install the cable prior to receiving the radio equipment).

Installation Activity	Time Required (Hours)
Travel to site	.5
Mount IDU	.5
Mount Antenna and ODU	1.0
Connect cable	.5

Typical commissioning of the Tel-Link Radio, described in terms of one link, will require two technicians, one for each end. After approximately 30 minutes to power up and perform local loop tests, approximately one hour is required to align the antennas. Once the antennas are aligned, the technicians can perform end-to-end BER testing, requiring one hour. After 30 minutes of typical customer defined ancillary tests, up to 60 minutes may be required to verify and demonstrate the link.

Installation Activity	Time Required (Hours)
Power up and local loop test	.5
Align antennas	1.0
BER testing of link	1.0
Ancillary tests	.5
Demonstrate, verify	1.0

As can be seen from the above tables, two technicians are required less than one day to install and commission a link. These times are estimated for a non-protected link. The above times are average estimates which are likely to be reduced considerably as technicians become more familiar with P-Com's products and associated deployment procedures.

4.2 Trial Link Procedures

To promote P-Com's millimetre wave products and to give customers exposure to their in-service performance, P-Com has developed a trial link procedure. In this manner, the end user can become familiar with the equipment and the link performance through a trial link which may be either their first procurement or a link borrowed from P-Com for a predetermined finite period of time. The objectives and elements of the P-Com trial link policy are provided below.

a) Trial Link Details

The end user will supply this information to P-Com:

- Terminal A and Terminal B site locations
- Terminal A and Terminal B frequencies
- Path length
- Polarization
- ODU mounting arrangements including pole diameters
- Power supply voltage (±24 or -48 vdc).

The link may carry live traffic. The multiplex interface, such as statistical multiplex or PCM channel bank, is to be provided by the end user. A link location close in proximity with a weather data collection station is recommended by P-Com. This allows the assessment of long-term propagation performance.

b) Bench Testing

Following is a list of typical system tests which the end user may be interested in performing prior to installation:

- RF Power output
- RF Spectrum
- Receiver Sensitivity
- E1 Loopback testing
- Sparing (practice swapping IDUs and ODUs)
- Other tests to be determined by the end user.

c) Installation

The end user may desire to monitor the time required for performing the following tasks:

- IDU mounting
- ODU mounting
- IDU-ODU cabling
- Antenna alignment
- Overall time for the above items
- Other items to be determined by the end user.

d) In-Service Performance

To ascertain the in-service performance capability of the link, the end user may want to monitor the following parameters:

- BER
- RSL
- Other items to be determined by end user

e) Items Provided by End User

- Cables
- Connectors
- Tools
- Test equipment
- Relay racks
- ODU mounting poles
- Other items to be mutually agreed between P-Com and the end user.

P-Com is willing to arrange with the end user the provision of materials required for the trial link. It is P-Com's intent that the end user have all materials necessary to perform successful trial link installations and observations.

5.0 Maintenance

The Tel-Link Radio has been designed so that no routine maintenance is necessary for the life of the equipment. Should any equipment failure occur, the alarm diagnostics built into the system will immediately identify the fault to the user.

However, if desired by the user, the following equipment checks can be performed and results recorded on a semiannual and annual basis:

Semi-Annual Visual Inspection:

a) Check the cable connections and the cable to the ODU for cracks, cuts or signs of connector corrosion (an actual cable open or short will be identified by the diagnostics as a cable fault alarm).

b) Clean the exterior surfaces of the ODU of any excess dirt or dust.

Annual Maintenance Checks:

a) Measure the AGC voltage and record.

b) Measure the output frequency.*

c) Measure the output power.*

* Requirements for these measurements is contingent upon the telecom regulations governing the use of this type of equipment in a particular country.

Notes

Appendix A - Terms

Terms

AIT	Air Interface Technology
BER	Bit Error Rate
BSC	Base Station Controller
BTS	Base Transceiver Station
CCIR	Consultative Committee for International Radio
CDMA	Code Division Multiple Access
CEPT	Conference of European Postal and Telecommunications operators
DTI	Department of Trade and Industry (UK)
E1	European Standard for Digital Transmission, 2.048 Mb/s
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FEC	Forward Error Correction
FSK	Frequency Shift Keying
GSM	Global System for Mobile Communications
IDU	Indoor Unit
IF	Intermediate Frequency
IK	Installation Kit
NRZ	Non-Return-to-Zero
NMS	Network Management System
ODU	Outdoor Unit
PCN	Personal Communications Network
PTT	Public Telephone & Telegraph
RSL	Received Signal Level
TDMA	Time Division Multiple Access

Reports

CCITT G.703	CCITT recommendation governing E1 interfaces.

EX PARTE PRESENTATION

INTERNATIONAL TELECOMMUNICATION UNION

RADIOCOMMUNICATION STUDY GROUPS

Document 9/BL/58-E
18 April 1994

Source: Doc. 9/155

Radiocommunication Study Group 9

DRAFT NEW RECOMMENDATION ITU-R F. [DOC. 9/155]

RADIO-FREQUENCY CHANNEL ARRANGEMENTS FOR RADIO-RELAY SYSTEMS OPERATING IN THE 55 GHz BAND

(Question ITU-R 108/9)

The ITU Radiocommunication Assembly,

considering

a) that the band 54.25 - 58.20 GHz is allocated to the fixed and mobile services and that the propagation characteristics of this band are ideally suited to very short range digital and analogue radio system applications;

b) that differing applications of various administrations may require different radio-frequency channel arrangements;

c) that several services with various transmission signal characteristics and capacities may be in simultaneous use in this frequency band;

d) that lower and upper limits of the bands are not uniform and vary internationally;

e) that the applications in this frequency band may require differing channel bandwidths;

f) that a high degree of compatibility between radio-frequency channels of different arrangements can be achieved by selecting channel centre frequencies within a homogeneous basic pattern;

g) that the differing digital hierarchies used in various countries or regions may require the use of homogeneous basic patterns with differing intervals;

h) that standardization of radio-frequency channel arrangements is desirable since atmospheric absorption is only significant in the upper part of the band,

recommends

1. that the preferred radio-frequency channel arrangements for the band 54.25 - 58.2 GHz should be based on homogeneous patterns;

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2. that the homogeneous pattern with a preferred 3.5 MHz interval be defined by the relation:

$$f_p = f_r + 3.5p \; MHz$$

where

$$1 \leq p \leq 1128$$

f_r: reference frequency of the homogeneous pattern;

3. that the homogeneous pattern with a preferred 2.5 MHz interval be defined by the relation:

$$f_p \doteq f_r + 2.5p \; MHz$$

where

$$1 \leq p \leq 1579$$

f_r: reference frequency of the homogeneous pattern;

4. that the reference frequency of the homogeneous pattern for international connections should be:

54 250 MHz;

5. that all go channels should be in one half of any bidirectional band, and all return channels in the other;

6. that the channel spacings, XS, the centre gap, YS, and the distance to the lower- and upper-band limits, Z_1S, Z_2S, should be agreed by the administrations concerned, dependent on the application and channel capacity envisaged (see Recommendation ITU-R F.746 for definitions of XS, YS and ZS).

Note - Examples of radio-frequency channel arrangements based on **recommends** 2 and 3 are described in the annexes to this Recommendation.

ANNEX 1

Radio-frequency channel arrangement in the band 54.25 - 57.20 GHz in accordance with recommends 2

In cases where a large fade margin is required, such as short-hop applications requiring a high availability, the difference in path loss between the transmit and receive channels, caused by the difference in atmospheric absorption, is of reduced significance compared to the total faded attenuation, including that due to precipitation. A single radio-frequency channel arrangement then becomes viable over a wide bandwidth such as 54.25 - 57.20 GHz.

An example of such a radio-frequency channel arrangement based on **recommends** 2 of this Recommendation for carrier spacings of 140 MHz, 56 MHz, 28 MHz and 14 MHz, is derived as follows:

let f_o be the centre frequency of 55 727 MHz = f_r + (422 x 3.5) MHz;

f_n be the centre frequency of a radio-frequency channel in the lower half of the band;

f'_n be the centre frequency of a radio-frequency channel in the upper half of the band,

then the frequencies of individual channels are expressed by the following relationships:

a) For systems with a carrier spacing of 140 MHz

Lower half of band: $f_n = (f_o - 1\,505 + 140\,n)$ MHz

Upper half of band: $f'_n = (f_o - 35 + 140\,n)$ MHz

where

$n = 1,2,3,...10$

b) For systems with a carrier spacing of 56 MHz

Lower half of band: $f_n = (f_o - 1\,463 + 56\,n)$ MHz

Upper half of band: $f'_n = (f_o + 7 + 56\,n)$ MHz

where

$n = 1,2,3,...25$

c) For systems with a carrier spacing of 28 MHz

Lower half of band: $f_n = (f_o - 1\,449 + 28\,n)$ MHz

Upper half of band: $f'_n = (f_o + 21 + 28\,n)$ MHz

where

$n = 1,2,3,...50$

d) For systems with a carrier spacing of 14 MHz

Lower half of band: $f_n = (f_o - 1\,442 + 14\,n)$ MHz

Upper half of band: $f'_n = (f_o + 28 + 14\,n)$ MHz

where

$n = 1,2,3,...100$

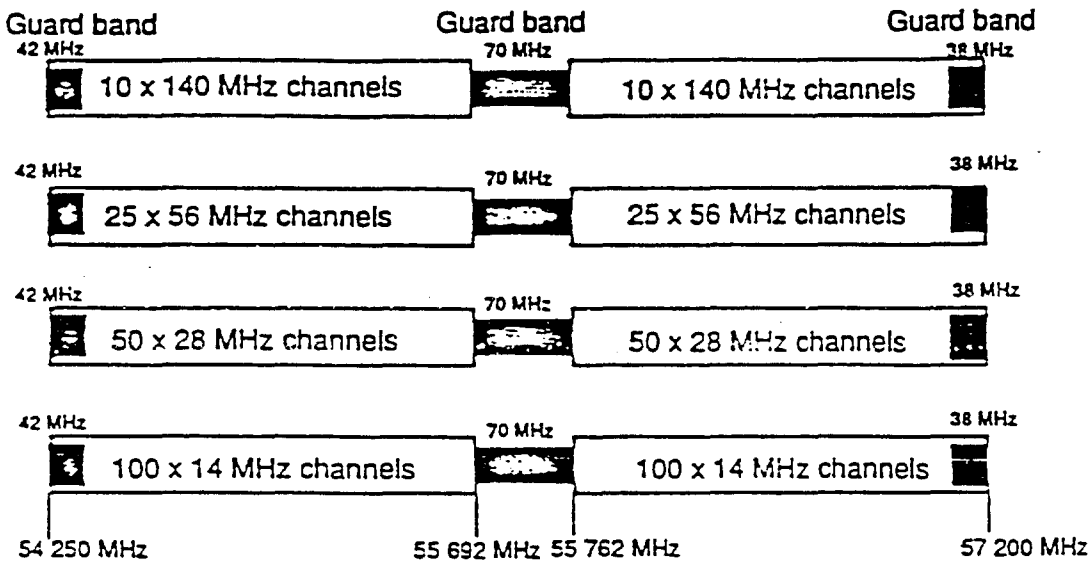
Note 1 - The radio-frequency channel arrangements of a) above has the use of channels 1 and 10 restricted to medium capacity systems due to the narrow centre guardband whilst channels 2 to 9 may be used for high capacity systems.

Note 2 - Table 1 gives occupied spectrum in the 54.25 to 57.20 GHz band. The centre and edge guardbands may be reduced, by agreement between administrations, to allow the use of an increased number of lower capacity systems.

This is achieved by the addition of extra channels derived from the homogenous pattern of **recommends** 2.

TABLE 1

Occupied spectrum 54.25 to 57.20 GHz band



ANNEX 2

Radio-frequency channel arrangements in the band 57.2 to 58.2 GHz in accordance with recommends 3

As an example the radio-frequency channel arrangement in the 57.2 to 58.2 GHz band may be composed of ten channels of 100 MHz based on **recommends** 3 of this Recommendation (see Table 2 below).

Only vertically polarized transmissions are recommended at this time.

TABLE 2

Channel centre frequencies

Channel number	Frequency (GHz)	Channel number	Frequency (GHz)
1	57.25	6	57.75
2	57.35	7	57.85
3	57.45	8	57.95
4	57.55	9	58.05
5	57.65	10	58.15